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SCIENTIFIC ARTICLE

Reinsertion of the Stylet does not affect Incidence of Post Dural Puncture Headaches (PDPH) after Spinal Anesthesia

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Abstract

Background and objectives: This study was conducted to investigate the effects of reinsertion of the stylet after a spinal anesthesia procedure on the Post Dural Puncture Headache (PDPH).

Methods: We have enrolled into this study 630 patients who were undergoing elective operations with spinal anesthesia and randomized them to Group A (stylet replacement before needle removal) and Group B (needle removal without stylet replacement). These patients were observed for the duration of 24 hours in the hospital and they were checked for PDPH on the 3rd and the 7th day of the study.

Results: Overall, the PDPH incidence was at 10.8% (68 patients). Thirty-three of these patients (10.5%) who were in Group A (stylet replacement before needle removal) and the other 35 patients (11.1%) who were in Group B (needle removal without stylet replacement) experienced PDPH. There was no significant difference between the two groups with respect to the PDPH.

Conclusions: In contrary to the diagnostic lumbar puncture, reinsertion of the stylet after spinal anesthesia with 25-gauge Quincke needles does not reduce the incidence of PDPH.

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Introduction

Lumbar puncture (LP) is a frequently performed procedure in anesthesia. Post Dural Puncture Headache (PDPH) after lumbar puncture is a common complication ¹ and carries considerable morbidity with symptoms lasting for several days; sometimes it is severe enough to immobilize the patient ².

The pain has a dull or throbbing nature and its intensity varies from mild to severe and is disabling. The postdural puncture headache can be best explained by prolonged spinal fluid leakage as a result of the delayed closure of a dural defect. Several factors contribute to its development after lumbar puncture, such as needle size, needle type, number of lumbar puncture attempts, needle bevel orientation, needle design,

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type of surgery, age, etc.³⁻⁵. On the other hand, replacement of the stylet after diagnostic lumbar puncture seems to reduce the postdural puncture headache⁶, but there is no large-scale randomized trial that studies this hypothesis.

This study was conducted to investigate the effects of reinsertion of the stylet after a spinal anesthesia procedure on the PDPH incidence.

Method

After obtaining an approval from the local ethical committee and a written informed consent, 639 patients (482 male, 148 female), aged 18-85 years, classified as ASA I and II were included in this study. At the time, they were all undergoing elective lower abdominal surgeries such as herniorrhaphy, hemorrhoidectomy or urological procedures such as transurethral resection, varicocele or lower limb operations under spinal anesthesia between the months of February and June of the year 2010. The study design was prospective, controlled and blinded.

Exclusion criteria were: patients younger than 18 and older than 80 years; patients to whom dural puncture was performed in the last 30 days, who have spinal deformities, migraine or other chronicle headache and diabetes mellitus⁷.

On the surgery day patients were taken to the operation theatre and a 18G cannula were inserted in an upper limb vein. Patients were given 100 mL.kg⁻¹ isotonic saline as pre-hydration treatment. Midazolam 0.06 mg.kg⁻¹ was administered intramuscularly (IM) for premedication.

The patients were randomly assigned to group A (stylet replacement before needle removal) and group B (needle removal without stylet replacement) (n = 315, in each) by using sealed envelopes.

All patients with successful dural puncture were included in the study. Nine patients (6 in group A and 3 in group B) were excluded from the study due to failed dural puncture and were replaced with newly randomized patients at the end of the study.

At the operation theatre, hemoglobin oxygen saturation (SpO₂), non-invasive systolic, diastolic and mean arterial blood pressure (SAP, DAP, MAP) and baseline electrocardiogram were recorded. Sterile drapes were applied after disinfection of the skin. Gauge 25 Quincke needles were used for dural puncture performed with the patient in sitting position at the L3-4 interspace by a midline approach. We used a bevel direction parallel to the dural fibers according to current American Academy of Neurology (AAN) guidelines^{8,9}. Spinal anesthesia was induced by 0.5 % hyperbaric bupivacaine 2.5 mL injected into the cerebro-spinal fluid (CSF). The patient was immediately returned to the standard supine position.

Sensorial block was assessed with pinprick test and motor block was tested according to Bromage's score (0: no motor block; 1: inability to hip flexion; 2: inability to flex knee; 4: inability to flex ankle)¹⁰. Number of attempts and the experience of anesthesiologist who performed the dural puncture were recorded. When spinal anesthesia was considered to be sufficient, the operation was allowed to start. Any hemodynamic or respiratory complication was recorded and treated intraoperatively.

At the end of the surgery, patients were transferred to the recovery room and hemodynamic, respiratory and lower extremity motor parameters were monitored and recorded for at least 30 minutes. When the patients were stable they were allowed to transfer to their wards. All of the patients were advised to remain recumbent for at least 12 hours following the spinal anesthesia. The patients were observed for 24 hours in the hospital and were checked at the 3rd and the 7th days for PDPH.

All patients were observed for any post spinal headache for 24 hours and checked by an anesthesiologist at the bedside 24 hours after spinal puncture procedure. They were questioned about their complaints regarding to spinal anesthesia (headache, nausea, back pain, tinnitus, dizziness, etc.). According to classification of headache disorders, headache after lumbar puncture is defined as bilateral headaches that develop within 7 days after a lumbar puncture and disappear within 14 days. The headache worsens within 15 min of resuming the upright position, disappears or improves within 30 minutes of resuming the recumbent position¹¹. Headaches were only recorded if they were as described in headache disorders classification.

On the third and seventh day after dural puncture patients were checked either at hospital or via telephone interview. All patients having PDPH 24 hours after dural puncture procedure were controlled either at bedside or in an anesthesiology polyclinic.

Four anesthesiologists conducted the study; two performed spinal anesthesia and worked during the intraoperative period and the other two who collected the postoperative data were blinded to the patient's.

Based on Strupp's paper we expected a PDPH rate of 5% for the stylet reinserted group and 16.3 for the stylet not reinserted group. Given these rates, a sample size calculation performed by DSS research sample size calculator (Washington D.C., U.S.A.) resulted in a total of 600 patients (with alpha = 0.05 and power 0.99). Taking into consideration a dropout rate of 5%, we finally started with a total of 630 patients.

Statistical analysis was performed via STATISTICA AXA 7.1 statistical analysis program (TULSA, USA). Results were given as mean (SD) and Median (Min-Max). The mean ages in groups were compared with Mann Whitney U test. Pearson Chi Square test was applied for comparison of PDPH's in Group A and B and p < 0.05 value was considered as statistically significant.

Results

Each group consisted of 315 patients, which did not differ significantly in age or sex. Mean age (Standard Deviation) was 48.42 (19.39), Median (Min-Max) age 47 (18-85) in stylet replacement before needle removal group (Group A) and 50.17 (19.79), Median (Min-Max) 51 (18-85) in needle removal without stylet replacement group (Group B). (Table 1).

All of the 24 hour controls, 259 third day controls and 122 seventh day controls were made either at patient's bedside or in anesthesiology polyclinic, 371 third day controls and 508 seventh day controls have been performed via phone interview.

Table 1 Age in Groups A and B.

	Age \geq 50 (n = 317) n (%)	Age < 50 (n = 313) n (%)	p
Group A	150 (47.3%)	165 (52.7%)	0.337
Group B	167 (52.7%)	148 (47.3%)	

**Figure 1** PDPH incidence in both groups and overall.

In the removed group with reinserted stylet (Group A) 33 patients (10.5%) experienced PDPH during the observation period and in the group without stylet reinsertion (Group B) 35 patients (11.1%) experienced PDPH during observation period. Overall PDPH incidence in both groups was 10.8% (68 patients) (Figure 1). There was no significant difference between the two groups with respect to the postdural puncture headache frequency during the assessment period ($p = 0.808$).

There was no significant difference between the two groups with respect to the anesthesiologists' experience ($p = 0.813$) (Table 2).

In Group A, 221 spinal anesthetics were given by assistants of anesthesiology and 94 spinal anesthetics by experts of anesthesiology. In Group B, assistants of anesthesiology gave 226 spinal anesthetics and experts of anesthesiology gave 89 spinal anesthetics ($p = 0.813$).

Out of 447 patients on whom spinal anesthesia was performed by an anesthesiology assistant 53 patients (11.8%) experienced PDPH during observation period. Fifteen (8.2%) of the 183 patients on whom anesthesiology experts performed spinal anesthesia experienced PDPH during observation period. There was no significant difference between dural punctures performed by anesthesiology and reanimation assistants and experts with respect to PDPH frequency during the assessment period ($p = 0.179$).

Dural puncture was performed with one attempt on 433 patients and 197 patients required more than one attempt. There was no significant difference between dural punctures performed with one attempt and with multiple attempts in Groups A and B ($p = 0.361$) (Table 2). We observed PDPH in 55 patients (12.7%) on whom dural puncture was performed with one attempt and 13 patients (6.6%) on whom dural puncture was performed with multiple attempts. PDPH was significantly more commonly observed in patients on whom dural puncture was performed with one attempt ($p = 0.022$).

According to type of surgery we have classified patients in seven groups. PDPH was observed significantly less in patients on whom transurethral resection was applied ($p = 0.032$). (Table 3)

Table 2 Experience of the Anesthesiologist and number of attempts for dural puncture in Group A and B.

	Assistants (n = 447) n (%)	Experts (n = 183) n (%)	p
Group A	221 (49.4%)	94 (51.4%)	0.813
Group B	226 (50.6%)	89 (48.6%)	
	1 Attempt (n = 433) n (%)	> 1 Attempts (n = 197) n (%)	p
Group A	226 (52.2%)	89 (45.2%)	0.361
Group B	207 (47.8%)	108 (54.8%)	

Table 3 PDPH according to type of surgery.

Type of Surgery	PDPH (+) (n = 68) n (%)	PDPH (-) (n = 562) n (%)	p
Hernia	17 (25.0%)	157 (27.9%)	0.609
Lower extremity ^(a)	17 (25.0%)	112 (19.9%)	0.328
Anorectal surgery	10 (14.7%)	56 (10.0%)	0.228
Arthroscopy	1 (1.5%)	14 (2.5%)	0.602
Pilonidal Sinus	12 (17.6%)	76 (13.5%)	0.354
Trans urethral resection	7 (10.3%)	120 (21.4%)	0.032*
Urological open surgery	4 (5.9%)	27 (4.8%)	0.698

^(a) Open surgery; *p < 0.05.

Discussion

Lumbar dural puncture is a common procedure for various diagnostic purposes also used for performing spinal anesthesia. Headache is one of the common complications of dural puncture and there is no correlation between the occurrence of PDPH and the indication; however, it is less frequent in anesthetic applications where fluid is injected and not removed in contrary to diagnostic lumbar puncture procedures. Headache incidence following spinal anesthesia is typically half of that which is seen with diagnostic LP ¹². PDPH occurs more often in young adults. Also, women with lower than normal body mass index ^{13,14} and pregnant women develop PDPH more commonly after lumbar puncture ¹.

PDPH usually occurs within 24 - 48 hours, but cases delayed up to 12 days have also been published ^{14,15}. Furthermore, cases with early onset - such as twenty minutes after spinal anesthesia - are reported ¹⁶. It is usually located in frontal and occipital areas and often radiates behind the eyes, to the neck and shoulders. Sometimes neck stiffness may be observed ^{11,14}. It is more severe in upright position and relieved in lying position. Also changing position and posture, e.g. head shaking, coughing, sneezing and straining may increase headache. Sometimes nausea, tinnitus, dizziness and diplopia may occur ^{11,14}. Mean duration of the PDPH is 7 days ¹¹, but may take weeks to resolve ¹⁷.

The pathophysiology of headache after lumbar puncture is unclear. However, it is probably due to the "remaining hole" in the dura after the needle has been withdrawn ¹⁸, resulting in persistent leakage of cerebrospinal fluid CSF from the subarachnoid space. This leakage might result in a fall in intracranial CSF volume and CSF pressure ¹⁹. In a normal human, 15-20 mL.hour⁻¹ CSF is produced. Although the loss of CSF and lowering of CSF pressure is not disputed, the actual mechanism is still not clear. There are two possible explanations. Firstly, the low CSF volume depletes the cushion of fluid supporting the brain and its sensitive meningeal vascular coverings, resulting in gravitational traction on the pain-sensitive intracranial structures causing classical headache, which worsens when the patient is upright and is relieved upon lying down; secondly, the decrease in CSF volume may activate adenosine receptors

directly, causing cerebral vasodilatation and stretching of pain-sensitive cerebral structures, resulting in headache after lumbar puncture ²⁰.

In this study, we found 10.8% overall PDPH incidence during 7 days observation period. In previous published studies Buettner (8.5%) ²¹, Devicic (7.1%) ²², Vallejo (8.7%) ²³, Evans (13%) ⁸ and Schmittner (16.9%) ²⁴ have shown comparable PDPH results with 25G Quincke needles.

In addition, there is no statistically significant difference between occurrence of PDPH and the experience of the performer of the spinal anesthesia. We observed PDPH in 53 (11.9%) patients treated by assistants of anesthesiology and in 15 (8.2%) patients treated by anesthesiology experts (p = 0.179). Operator experience (with spinal anesthesia) was stated as a modifiable risk factor in Bezov's paper on PDPH ¹⁴ but this data was based on MacArthur's finding in 74 accidental dural puncture during epidural anesthesia procedure in pregnant women ²⁵. According to this data, accidental dural puncture and PDPH was more common when number of previous epidural anesthetics given was less than 10 ²⁵. Our assistants were more experienced in spinal anesthesia (number of previous spinal anesthetics given > 100) and therefore we could not demonstrate a statistically significant difference between PDPH related to spinal anesthetics given by assistants versus experts.

We have observed significantly less PDPH after Trans Urethral Resection (TUR) operations (p = 0.032). This subgroup of patients is older than the others (mean age = 65.6) and we are assuming that this statistically significant data is related to the age of patients in this group ^{14,26}.

In our study, PDPH was more often observed in patients with one dural puncture and this was statistically significant (p = 0.022). In previous studies, Lybecker could not find a significant interaction between PDPH and number of punctures (p = 0.091) ²⁶ on 1021 patients but Seeberger found that repeated dural punctures significantly increased the incidence of PDPH ⁴ on 8,034 patients. Our study was not designed for analyzing infrequently occurring predictors of PDPH such as repeated dural puncture. Therefore our sample size is not large enough. Although not statistically significant (p = 0.549) the patients in multiple attempt group were older

(mean age: 53.2) than the single attempt group (mean age: 47.3) and it is known that younger patients are more prone to developing PDPH¹⁴.

Since the paper published by Strupp et al.⁶ in 1998, some reviews have mentioned that the reinsertion of the stylet before needle removal after dural puncture may decrease the incidence of PDPH²². According to Strupp et al PDPH, incidence after spinal anesthesia is much lower than after diagnostic lumbar puncture. This difference could be caused by a strand of arachnoid, which might enter the needle with the outflowing cerebrospinal fluid during diagnostic LP and upon removal of the needle be threaded back through the dura to produce prolonged CSF leakage. But there is no published experiment available conducted for dural puncture in spinal anesthesia. In 2004, Deibel et al found via a Medline - Cochrane database search of the years 1966 - 2004 that Strupp's paper is the only one about the effect of stylet reinsertion on PDPH²⁷. Strupp and co-workers found in a randomized trial on 600 patients that patients without reinsertion of the stylet developed PDPH more often than patients with reinsertion (16.3 versus 5.0%, $p < 0.005$)⁶. Our PDPH occurrence results after seven days observation period without stylet reinsertion is 11% and with reinsertion is 10.5%, which are not corresponding with Strupp's results and we could not demonstrate a statistically significant difference between our groups. This is probably due to the purpose of the lumbar puncture. Spinal anesthesia differs from diagnostic LP; needle gauges are smaller than used in diagnostic LP, smaller volumes of CSF are drawn and small volumes of anesthetics are injected. In contrary, during diagnostic lumbar punctures usually there is nothing given through the needle. Liquid pushed through the needle during spinal anesthesia could push back the strand of arachnoid, which might enter the needle during LP.

Conclusion

Unlike diagnostic lumbar puncture, reinsertion of the stylet after spinal anesthesia with 25-Gauge Quincke needles does not reduce the incidence of PDPH.

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